

SECTION 18450
DUCTWORK WELDING PROCEDURE SPECIFICATIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. WPSs for welding ductwork on-site.

1.2 RELATED SECTIONS

- A. Section 18100, General Welding Requirements.
- B. Section 18410, General Ductwork Welding Requirements.
- C. Section 18470, Ductwork Weld Joint Details.

PART 2 - PRODUCTS

- A. See Section 18100, General Welding Requirements.

PART 3 - EXECUTION

3.1 PROCEDURES

- A. Each ductwork WPS is uniquely labeled to indicate the welding process, base material(s), and weld joint type, as follows:

XX-YY-N(DW)

Where:

XX = Welding process abbreviation

YY = Base material P-number from ASME Sect. IX

N = Sequence number

DW = Designates a ductwork WPS

1. Welding processes:
 - a. SM - Manual Shielded Metal Arc.
 - b. GT - Manual Gas Tungsten Arc.
 - c. GM - Gas Metal Arc, Semiautomatic.
2. Base materials:
 - a. Ferrous.
 - 1) PI - Carbon Steel.
 - 2) P8 - Austenitic Stainless Steel.
 - b. Nonferrous.
 - 1) P21 - Aluminum Alloy (to 1.2 Mn).
 - 2) P22 - Aluminum Alloy (to 1.2 Mn, 3.5 Mg, 0.25 Cr).
 - 3) P23 - Aluminum Alloy (to 1.0 Mg, 0.6 Si, 0.25 Cr).
 - 4) P24 - Nickel-Base Alloys.

- B. Each WPS specifies welding conditions, including base materials, current, current type, voltage, polarity, electrode size and type, filler materials, shielding gas type and flow rate, purging gas, preheat, postweld heat treatment, etc. Do not use variables not specifically addressed by the applicable WPS.

- C. Weld joint types shall be in accordance with Section 18470 (available from the CM upon request).

DUCTWORK WPS SUMMARY

WPS	BASE MATERIAL	FILLER MATERIAL	THICKNESS	COMMENTS
CARBON STEEL				
GT11-1(DW)	Carbon Steel	ER70S-2 or -3	0.0239 - 0.239	Note 1
GT11-2(DW)	Galvanized Carbon Steel	ER70S-2 or -3	0.0258 - 0.1032	Note 1
SM11-1(DW)	Carbon Steel	E6010	0.125 - 0.239	Note 1
GM11-1(DW)	Carbon Steel	ER70S-3	0.0239 - 0.125	Short Arc
STAINLESS STEEL				
GT88-1(DW)	Stainless Steel	300 Series	0.0179 - 0.239	Note 1
GT88-2(DW)	Stainless Steel	ER308LFC	0.062 - 0.239	Flux-Coated Rod
GM88-1(DW)	Stainless Steel	300 Series	0.0188 - 0.125	Short Arc
ALUMINUM ALLOYS				
GT23.23-1(DW)	1100,6061	ER4043	0.031 - 0.239	Note 1
CARBON STEEL TO STAINLESS STEEL				
GT18-1(DW)	Carbon Steel to Stainless Steel	ER309 or ER309L	0.062 - 0.239	Note 1
PLATINUM				
GTPT-1(DW)	Platinum to Platinum	Platinum	0.031 - 0.125	

Note 1: WPS also qualified for the attachment and joining of any member, regardless of thickness, whose sole purpose is stiffening, supporting, or reinforcing the sheet metal. It also applies to the attachment of accessories or components of the system.

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT11-1(DW)**
REVISION: **1**

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 1 or any carbon steel with 0.30% max carbon and 0.50% max chromium
Qualified Thickness Range: 0.0239 in. through 0.239 in. for ductwork; unlimited for stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.18 F-number 6 and A-number 1
Class: ER70S-2 or ER70S-3
Deposited Thickness Range: Groove 0.0239 in. through 0.239 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 500EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER70S-2 or ER70S-3
Filler mtl diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	25-120
Arc voltage (volts)	10-13
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	(see Note)
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT11-1(DW)**
REVISION: **1**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GT11-1(DW)
GT11-1A(DW)

Note: Argon purge at 5 cfh min may (and shall when specified by the user organization) be used with this WPS.

Energy Systems: Original signature on file Date: 7/30/93

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DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT11-2(DW)**
REVISION: 0

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): Galvanized P-number 1 or any carbon steel with 0.30% max carbon and 0.50% max chromium
Qualified Thickness Range: 0.0258 in. through 0.1032 in. for galvanized ductwork; unlimited for stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.18 F-number 6 and A-number 1
Class: ER70S-2 or ER70S-3
Deposited Thickness Range: Groove 0.0258 in. through 0.1032 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 500EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER70S-2 or ER70S-3
Filler mtl diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	25-120
Arc voltage (volts)	10-13
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	N/A
Purging gas (cfh)	N/A
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT11-2(DW)**
REVISION: **0**

POSITIONS:

- * All positions (vertical welding upwards).

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GT11-2(DW)

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DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **SM11-1(DW)**
REVISION: **0**

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual SMAW-MA

BASE MATERIAL(S): P-number 1 or any carbon steel with 0.30% max carbon and 0.50% max chromium
Qualified Thickness Range: 1/8 in. through 0.239 in. for ductwork; unlimited for stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.1 F-number 3 and A-number N/A
Class: E6010
Deposited Thickness Range: Groove 1/8 in. through 0.239 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 500EF max

WELDING CONDITIONS:

Process	SMAW
Increment	All
Polarity	DCRP
Electrode	E6010
Electrode diam (in.)	3/32
Current (amps)	25-105
Arc voltage (volts)	22-26

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **SM11-1(DW)**
REVISION: **0**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - SM11-1(DW)

Energy Systems: Original signature on file Date: 7/30/93

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GM11-1(DW)**
REVISION: **1**

DATE: February 2, 1994

COMPANY NAME: Energy Systems

WELDING PROCESS: Semiautomatic GMAW-S (Short-Circuiting Arc)

BASE MATERIAL(S): P-number 1 or any carbon steel with 0.30% carbon and 0.50% max chromium
Qualified Thickness Range: 0.0239 in. through 0.125 in. for ductwork, stiffeners, supports, and attachments (R)

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.18 F-number 6 and A-number 1
Class: ER70S-3
Deposited Thickness Range: Groove 0.0239 in. through 0.125 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 500EF max

WELDING CONDITIONS:

Process	GMAW-S
Increment	All
Polarity	DCRP
Weld filler material	ER70S-3
Electrode diam (in.)	0.030, 0.035
Current (amps)	40-120
Arc voltage (volts)	15-23
Shielding gas	75% Argon, 25% CO ₂
Shielding gas (cfh)	15-25
Purging gas	None
Purging gas (cfh)	N/A
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GM11-1(DW)**
REVISION: **1**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GM11-1(DW)
GM11-1A(DW)

Energy Systems: Original signature on file Date: 2/18/94

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT88-1(DW)**
REVISION: **2**

DATE: January 31, 1995

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 8 or other austenitic stainless steels with similar composition
Qualified Thickness Range: 0.0179 in. through 0.239 in. for ductwork;
unlimited for stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.9 F-number 6 and A-number 8
Class: See Table 1 (ER3XX)
Deposited Thickness Range: Groove 0.0179 in. through 0.239 in., fillet
unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	See Table 1
Filler mt'l diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	15-165
Arc voltage (volts)	7-14
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	5 min
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT88-1(DW)**
REVISION: **2**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GM88-1(DW)
GM88-1A(DW)

TABLE 1
Filler Metal to Use for Specified Base Metals

BASE METAL	302,304, 304H	304L	317	321,321H, 347	309	316 316H	316L	318
302,304, 304H	ER308	ER308	ER308	ER308	ER308	ER308	ER308	ER308
304L	ER308	ER308L	ER308	ER308	ER308	ER308	ER308L ER316L	ER308
317	ER308	ER308	ER317	ER347	ER309	ER316	ER316	ER317
321,321H, 347	ER308	ER308	ER347	ER347	ER309	ER316	ER308	ER308
309	ER308	ER308	ER309	ER309	ER309	ER316	ER308	ER309
316,316H	ER308	ER308	ER316	ER316	ER316	ER316	ER316	ER316
316L	ER308	ER308L ER316L	ER316	ER308	ER308	ER316	ER316L	ER316
318	ER308	ER308	ER317	ER318	ER309	ER316	ER316	ER318

ER308L may be substituted for ER308 if the tensile strength is 80 KSI minimum.
ER316L may be substituted for ER316 if the tensile strength is 75 KSI minimum.

Energy Systems: Original signature on file Date: 1/31/95

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT88-2(DW)**
REVISION: 0

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): Type 304 or 304L austenitic stainless steels
Qualified Thickness Range: 1/16 in. through 0.239 in. for ductwork

IMPACTS: No

FILLER MATERIAL(S): Type: SFA N/A F-number N/A and A-number 8*
Class: ER308LFC (Proprietary Flux-Coated Rod)
Deposited Thickness Range: Groove 1/16 in. through 0.239 in.

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DSCP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER308LFC
Filler mt'l diam (in.)	3/32, 1/8
Current (amps)	15-165
Arc voltage (volts)	7-14
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	None
Purging gas (cfh)	N/A
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S): * Applicable only to open root butt welds when purging is not feasible.
* This procedure to be used only when approved in writing by a Senior Welding Inspector or Welding Technologist.

POSITIONS: * All positions (vertical welding upwards).

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* Determined from manufacturer's Certificate of Analysis.

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT88-2(DW)**
REVISION: **0**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GT88-2(DW)

Energy Systems: Original signature on file Date: 7/30/93

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GM88-1(DW)**
REVISION: **2**

DATE: January 31, 1995

COMPANY NAME: Energy Systems

WELDING PROCESS: Semiautomatic GMAW-S

BASE MATERIAL(S): P-number 8 or other austenitic stainless steels with similar composition
Qualified Thickness Range: 0.0188 in. through 0.125 in. for ductwork, stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA 5.9 F-number 6 and A-number 8
Class: See Table 1 (ER3XX)
Deposited Thickness Range: 0.0188 in. through 0.125 in.

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GMAW-S (Short-Arc)
Increment	All
Polarity	DCRP
Weld filler material	See Table 1
Electrode diam (in.)	0.030, 0.035
Current (amps)	40-120
Arc voltage (volts)	15-23
Shielding gas	98% Argon, 2% O ₂
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	5 min
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GM88-1(DW)**
REVISION: **2**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GM88-1(DW)
GM88-1A(DW)

TABLE 1
Filler Metal to Use for Specified Base Metals

BASE METAL	302,304, 304H	304L	317	321,321H, 347	309	316 316H	316L	318
302,304, 304H	ER308	ER308	ER308	ER308	ER308	ER308	ER308	ER308
304L	ER308	ER308L	ER308	ER308	ER308	ER308	ER308L ER316L	ER308
317	ER308	ER308	ER317	ER347	ER309	ER316	ER316	ER317
321,321H, 347	ER308	ER308	ER347	ER347	ER309	ER316	ER308	ER308
309	ER308	ER308	ER309	ER309	ER309	ER316	ER308	ER309
316,316H	ER308	ER308	ER316	ER316	ER316	ER316	ER316	ER316
316L	ER308	ER308L ER316L	ER316	ER308	ER308	ER316	ER316L	ER316
318	ER308	ER308	ER317	ER318	ER309	ER316	ER316	ER318

ER308L may be substituted for ER308 if the tensile strength is 80 KSI minimum.
ER316L may be substituted for ER316 if the tensile strength is 75 KSI minimum.

Energy Systems: Original signature on file Date: 1/31/95

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT23.23-1(DW)**
REVISION: **1**

DATE: May 14, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 23 and P-number 21 in any combination
Qualified Thickness Range: 0.031 in. through 0.239 in. for ductwork; unlimited
for stiffeners, supports, and attachments

FILLER MATERIAL(S): Type: SFA 5.10 F-number 23 and A-number N/A
Class: ER 4043
Deposited Thickness Range: Groove 0.031 in. to 0.239 in., fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	ACHF
Electrode	EWP
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER 4043
Filler mt'l diam (in.)	1/16, 3/32, 1/8
Current (amps)	60-200
Arc voltage (volts)	--
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	See Note
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT23.23-1(DW)**
REVISION: **1**

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GT23.23-1(DW)
GT23.23-1A(DW)

Note: Argon purge at 5 cfh min may (and shall be used when specified by the user organization) be utilized with this WPS.

Energy Systems: Original signature on file Date: 7/30/93

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT18-1(DW)**
REVISION: 0

DATE: July 26, 1993

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): P-number 1 or any carbon steel with 0.30% max carbon and 0.50% max chromium
Qualified Thickness Range: 0.0239 in. through 0.239 in. for ductwork;
unlimited for stiffeners, supports, and attachments

IMPACTS: No

FILLER MATERIAL(S): Type: SFA5.9 F-number 6 and A-number 8
Class: ER309 or ER309L
Deposited Thickness Range: Groove 0.0179 in. through 0.239 in., fillet
unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	ER309 or 309L
Filler mtl diam (in.)	0.030, 0.035, 0.045, 1/16, 3/32, 1/8
Current (amps)	25-120
Arc voltage (volts)	10-13
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	Argon
Purging gas (cfh)	5 min
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use backing material only when specified on drawings or specifications.

POSITIONS:

- * All positions (vertical welding upwards).

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GT18-1(DW)**
REVISION: 0

TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GT18-1(DW)
GT18-1A(DW)

Energy Systems: Original signature on file Date: 7/30/93

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GTPT-1(DW)**
REVISION: **0**

DATE: September 20, 1994

COMPANY NAME: Energy Systems

WELDING PROCESS: Manual GTAW-MA

BASE MATERIAL(S): Platinum to Platinum
Qualified Thickness Range: 0.031 in. through 0.125 in.

IMPACTS: No

FILLER MATERIAL(S): Type: Platinum
Deposited Thickness Range: Fillet unlimited

PREHEAT/INTERPASS: Preheat: 50EF min
Interpass: 350EF max

WELDING CONDITIONS:

Process	GTAW
Increment	All
Polarity	DCSP
Electrode	AWS A5.12
Electrode diam (in.)	1/16, 3/32, 1/8
Weld filler material	Platinum
Filler mt'l diam (in.)	1/8 in. wide strips of platinum base material
Current (amps)	15-100
Arc voltage (volts)	7-14
Shielding gas	Argon
Shielding gas (cfh)	15-25
Purging gas	None
Purging gas (cfh)	N/A
Gas cup size (in.)	1/2 max

PWHT/PREHEAT MAINTENANCE: N/A

JOINT TYPE(S):

- * Those specified in Sect. 18470 or on drawings or specifications.
- * Full penetration (open butt, with backing or backgouged).
- * Partial penetration, fillet, build-up, and repair.
- * Use copper backing material when necessary to avoid burn-through.

POSITIONS:

- * Flat, horizontal, and vertical up.

DUCT WELDING PROCEDURE SPECIFICATION (WPS)
AWS D-9.1

NUMBER: **GTPT-1(DW)**
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TECHNIQUE(S):

- * Initial and interpass cleaning - wire brushing (hand or power), grinding, chipping, burring, filing, or other suitable methods. Dull gray oxide coating must be removed to bright metal prior to welding.
- * Method of backgouging - chipping, grinding, machining, air-carbon arc gouging, or other suitable methods.
- * Multipass or single pass - single or multipass as required.
- * Variables not listed in this WPS or Section 18410 are not applicable.

REFERENCES:

- * Section 18410
- * Supporting PQR(s) - GTPT-1(DW)

Energy Systems: Original signature on file Date: 9/20/94

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END OF SECTION 18450